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Abstract

Presented are 75 suggestions for investigating in grades K-6 such common urban resources as trees, seeds, polluted air, rocks, and insects. The manual is designed for use with the Urban Discovery Box which contains samples collected from eight urban resources along with some objects helpful to investigate these. A section in the manual for each of the eight resources provides teachers with needed information for helping the pupils carry out their investigations. Many potential problems for investigation are directed at the development of such science processes as hypothesis formation, observation, data collection, the making of inferences, classification, and formulation of problems. Numerous discussion questions are also included. A complete list of resource materials is provided for the development of a "discovery box." This work was prepared under an ESEA Title III contract. (RS)

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URBAN DISCOVERY MANUAL

75

STIMULATING IDEAS for INVESTIGATING SOME COMMON URBAN RESOURCES INDOORS AND OUTDOORS

GRADES K-6

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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By Dr. Phyllis S. Busch
Project Director, S.P.R.U.C.E.

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1969

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INTRODUCTION

Purpose of the Urban Discovery Box

There are several points of agreement among the members of the science-teaching community today. It is accepted that "telling the facts of science" is a waste of time. Telling is not teaching and facts are easily forgotten. Moreover, "solid facts" change.

However, there are so-called "big ideas" or "conceptual schemes" which do not change. One example is that living things in a community interact with each other and with their environment. Another "big idea" is that everything is constantly changing; nothing remains static.

Another point of agreement is that learning by inquiry -- by exploring -- by investigating is a most fruitful way to pursue one's education. Such learning involves the child in problem-solving. Great emphasis is placed on the processes of science. One might say that children who are exposed to such techniques learn how to learn.

Everyone may not agree on the extent of the sorry condition of our planet but all will accept that there is a great need for improvement. Science has been used to develop a technology which is decreasing the earth's resources while it is increasing air and water pollution, crowds, junk, noise, ugliness. Man suffers from all of this. Little has been done to combat or prevent these conditions either through ignorance of the consequences or through indifference.

Man is a part of the world of living things and reacts to environmental changes as do other living things. This calls for an ecological emphasis in our teaching. Such emphasis will logically lead to conservation. Conservation is something active. One has to do something. When man realizes that only he can willingly alter his environment and that only he can predict the outcomes of these alterations perhaps he will be prepared to assume a sense of responsibility which he will translate into action. It is agreed that this might be achieved by inculcating appropriate attitudes and values. How? By education. Who? Everyone -- beginning with Kindergarten.

Project S.P.R.U.C.E. recognizes and adheres to these points of agreement. Where there are uncertainties decisions have to be made. Conservation should not be taught as a separate course. In this guide science is used as a logical vehicle for including an opportunity for children to develop conservation concepts. Social studies is another such avenue. Actually, there is not a single curriculum area in which the teacher is free of responsibility to educate for conservation literacy - an achievement which would manifest itself in behavior essential to successful living on this planet for all.

In order to emphasize man's relation to and interaction with his environment, teachers must provide experiences in the <u>total environment</u> - outdoors as well as indoors.

It has usually been accepted that environmental studies are synonymous with country field trips. This notion must change. Teachers should realize that if our objective is to develop a citizenry which is environmentally literate, then all aspects of all environments demand study. It is more urgent than ever for all of us, no matter where we live to be informed of the urban environment. We must recognize that over seventy-five per cent of the people in the United States live in cities, that what goes on in cities affects the quality of life in the rest of the country.

The Urban Discovery Box is but one small way that has been designed to introduce city children to their world -- indoors and out. They are stimulated and made aware of some parts of their environment by exploring small samples taken from it. They are led to inquire and to investigate. The results will be most profitable where the children recognize interrelationship and where they realize the consequences of man's manipulations with the environment. Nowhere is this more dramatic than in the cities. Best of all will be those lessons which result in constructive action by the children of each grade level. When changes in attitudes and values can modify the behaviors of children so that they do something toward improving a recognizably bad situation, an enlightened citizen is being developed.

How to Use the Urban Discovery Box

The 50 items in the Urban Discovery Box consist of samples collected from eight urban resources together with some objects helpful to investigate these. All are packaged and clearly labeled.

For each of the eight resources the manual has a section called, "Background". This provides the teacher with needed information for helping the pupils carry out their investigations.

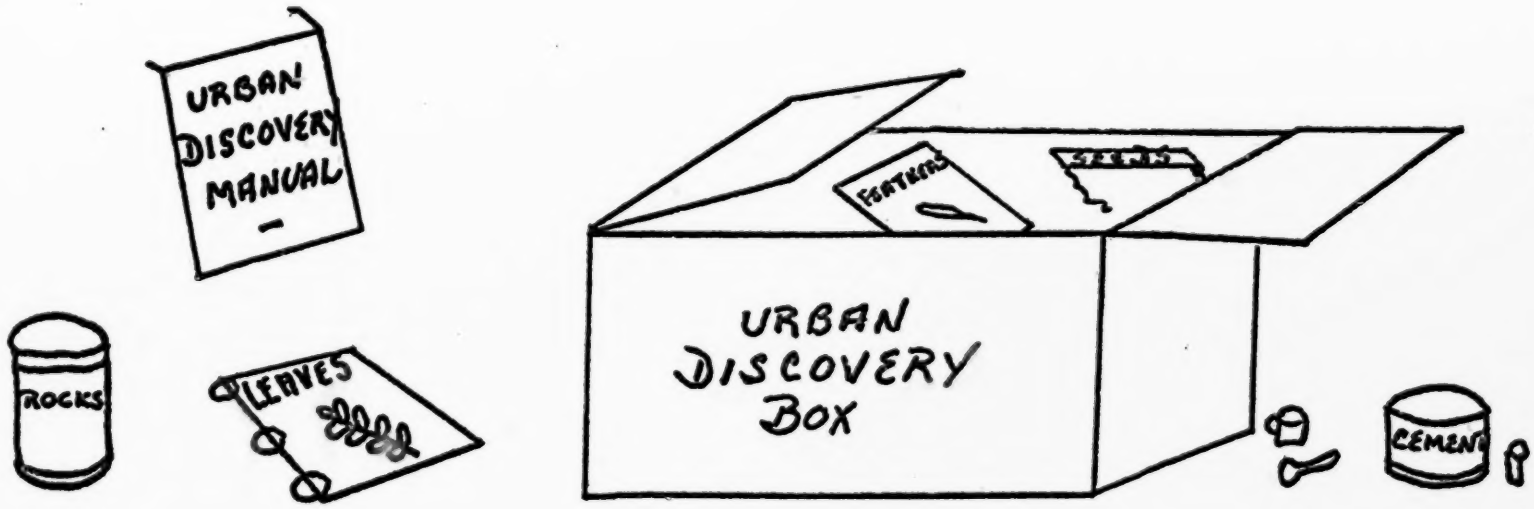
This background section is followed by several suggested problems to be investigated. These are designed to motivate the children to learn something about this sample taken from their world. They are guided to hypothesize, observe, collect data, make inferences, develop new problems, design experiments, classify, and generally gain practice in the processes of science. The teacher should encourage the introduction of as many original investigations as possible.

Following the several suggested investigation of each resource is a list of recommended discussion questions. These questions serve as a guide to bring out interrelationships and conservation implications. It is hoped that from these discussions the teacher will help to direct some form of concrete action by the pupils.

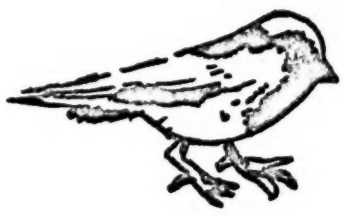
The 50 items included in the Urban Discovery Box are listed in the "Index" for easy reference.

It should be noted that the manual was designed to help open the eyes of teachers and pupils in urban areas to their resources and the resource studies which these make possible.

The manual can be used with or without the Urban Discovery Box. The number of Boxes which were originally assembled is very much limited. Any teacher can easily collect the 50 items by referring to the complete list in the back of the manual and thus prepare his own Urban Discovery Box.



BIRDS AND FEATHERS



HOUSE SPARROW

BACKGROUND:

A feather is a development from the outermost layer of a bird's skin. Only birds have feathers. Even though all birds do not fly, there is no bird lacking feathers.

There are three principal kinds of feathers: small feathers which cover the body and are known as contour feathers, larger stiff feathers of the tail and outer half of the wings and tips known as flight feathers, and down feathers found on most baby birds and under the contour feathers of many water birds such as ducks.

A feather consists of three parts: the quill (or shaft) which provides support: the barbs coming off the quill to form a fan-like web: and the fluffy part nearest the body.

Birds molt their feathers at least once a year--in the late summer or fall and in late winter or spring.

Sparrows and pigeons are common city birds.

Male sparrows have a black "bib" and white cheeks. There is no bib in the female. Everyone recognizes pigeons. Pigeon feathers can be collected from the ground below a pigeon roosting spot.

Starlings frequent cities too, gathering in large noisy flocks at night.

A card with two flight feathers is provided: one of a chicken and one of a pigeon. The bag of mixed feathers consists chiefly of body or contour feathers. These are feathers of several different kinds of game birds.

The card also has a sample of goose down. Goose down is used for making down quilts, sleeping bags, coats.

If there is a live poultry market in the city more chicken feathers as well as turkey feathers might be obtained for comparative studies.

A diagram of the parts of a feather is provided.

Investigations:

1. Compare the pigeon feather, chicken feather, and goose down.

2. What happens when the barbs of a feather separate? How can you put them together? (A magnifier is recommended.) Observe any bird which is not flying. How do birds smooth their feathers? How does it help the bird to keep his feathers smoothed?

3. Perhaps you can discover why it is important to birds to have perfect feathers by making a paper fan. Fan yourself. Now cut out a few pieces of the fan. Fan yourself again. What is the difference? With the help of a magnifying glass you might see the little hooks on the parts of the feather which help to make it smooth.

4. Examine the bag of feathers. Compare these body feathers to the flight feathers. When you have finished examining them you might wish to make a little feather pillow. The finest pillows, comforters and sleeping bags are filled with down. Examine the goose down to see how soft it is. What makes the down so soft?

5. Look for a resting sparrow or pigeon on a very cold day. Why does it seem fatter than on a hot day? Hold your bare arm out in the cold. How do the hairs of your arm capture a blanket of air? What warms this blanket of air? Can you explain how fluffing out its feathers on a cold day keeps a bird warm? Perhaps you can discover how the birds use these same feathers to keep cool on a hot day.

6. Go on a feather hunt. If you know where starlings or pigeons roost you can find some feathers. Or you might just happen to find other kinds of feathers almost anywhere.

7. Look for some common birds such as starlings, sparrows or pigeons. Describe their colors. There are no differences between male and female colors among starlings. How can you tell the difference between male and female sparrows? Discover other birds in which the feathers of the sexes are colored differently.

8. Observe the behavior of pigeons and sparrows in order to find out whether the males and females behave differently or the same.

9. Discuss:

   a. Why do so many water birds die when oil is added to water where these birds swim?
   b. What are the sources of these oil additions?
   c. What can be done about this?
   d. What else besides gulls are attracted to garbage dumps?

e. Why is garbage disposal such a serious problem?
f. What are some ways of improving garbage disposal?
g. Why are starlings, pigeons, sparrows unattractive? attractive? Why do they live in cities? They are all "immigrants". From where did they come? Why are they successful in cities?

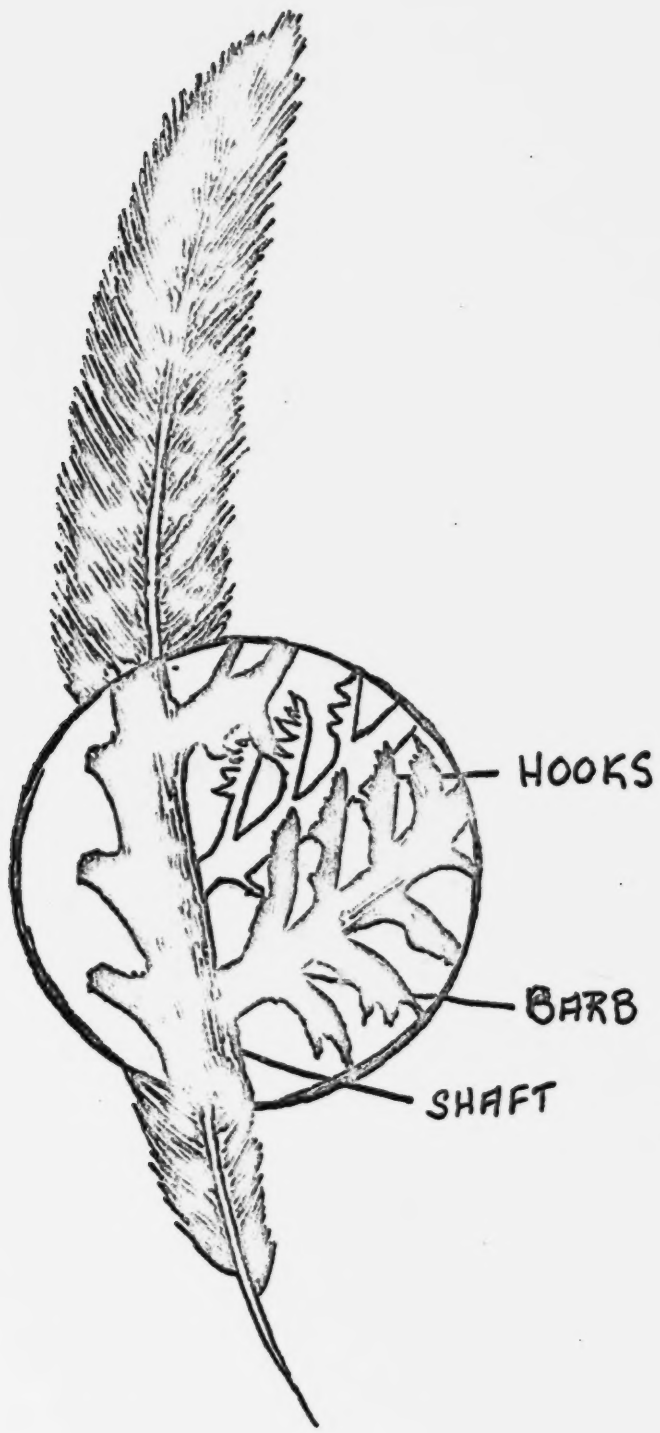


DIAGRAM OF FEATHER

COCKROACHES

BACKGROUND:

ADULT COCKROACH

Grasshoppers are common in meadows in the summer. A relative, the cockroach can be found all year round, surviving indoors. It is not restricted to the city. Many country homes are infested with roaches too. However, this pesty insect is more frequently found in the cities, and in crowded apartments - where you are not apt to find butterflies, dragonflies and katydids.

Cockroaches have been around a long, long time, starting their history at the time when coal was in the process of being formed, millions of years ago. Cockroaches existed when dinosaurs first appeared on earth. And when these reptiles became extinct the roaches continued to live and survive to this very day.

There are many kinds of cockroaches, not all are pests. The smallest, known as the German cockroach is also the one that gives people the most trouble. These are the insects that crawl out of the woodwork at night. They are less active by day. Most cockroaches carry on their activities when the day is over.

They feed on almost anything: garbage, soap, cigars, wallpaper, books, all kinds of fresh food. A smelly brown deposit is left around the holes leading to their homes and all along the trails they travel. The food which they visited is also spotted with this brown substance.

There are just three stages in the development of a cockroach. From the eggs hatch numphs, who in a half hour begin to resemble the adults. A roach may live about two and one-half years and deposit some 1800 eggs in its life time. Some enemies of cockroaches are toads, centipedes and man. The best way to get rid of them is to discourage them by making food unavailable. Poisons and sprays are dangerous to people and pets.

EGG AND NYMPH OF COCKROACH

INVESTIGATIONS:

1. Where are cockroaches found?

Cockroaches feed at night. By day you can detect their presence from certain clues. They give off little brown specks - dots which they leave behind on food, around the holes from which they emerge to seek their food, and along the areas over which they crawl. The brown material has a definite odor - cockroach odor.

Look around the floor, woodwork, and where it is dark and damp. Can you see signs of cockroaches? Do you smell signs of cockroaches?

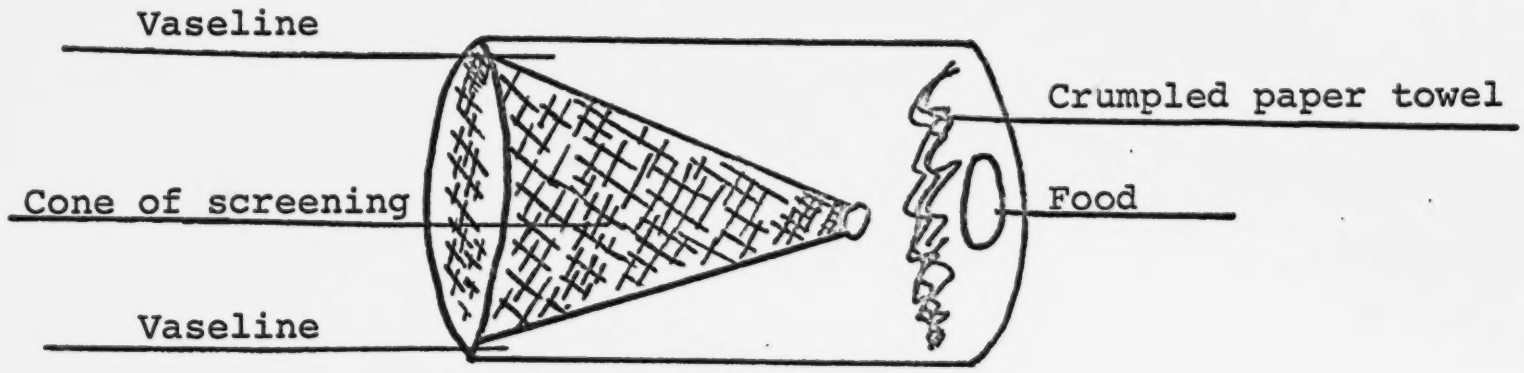
2. How can you attract cockroaches?

A cockroach trap can be made out of a pint jar, such as a mayonnaise jar. Cut a piece of fine screening into the shape of a cone. The narrow opening of the cone should be about 1/2 inch wide and about one inch above the bottom of the jar. The wide top of the cone should extend long enough to overlap the top of the jar. Sew the sides of the cone.

Spread a thin coat of vaseline on the inside of the top inch of the jar. Place a slice of very ripe banana or other rotten fruit in the bottom of the jar. Then put some crumpled paper toweling on top of the fruit. Lay the cockroach trap (jar) on its side.

The trap should be left where placed for a day or two. After some cockroaches have entered the trap screw the lid on to keep the insects inside.

The top of the lid should be replaced with screening so that air enters the jar.



COCKROACH TRAP

3. Where are most of the cockroaches found?

Make several traps. Place them in different parts of the room where you are trying to locate them: near a pipe, under a table, in a dark corner, a light corner, etc.

Investigations (continued)

4. How does the cockroach compare to other insects?
Try to catch a fly by inverting a clear plastic tumbler over it. Compare the number, size, shape, and color of the parts of the body, wings, legs. Compare their means of movement and the ways in which they clean themselves.

5. Among the closest relatives to the cockroaches are crickets, praying mantises, and grasshoppers. Secure an example of these if you can and examine them to find out how they resemble cockroaches and how they are different.

6. Discuss:

   a. What are the changes man has made which makes life in the city different from life in the country?

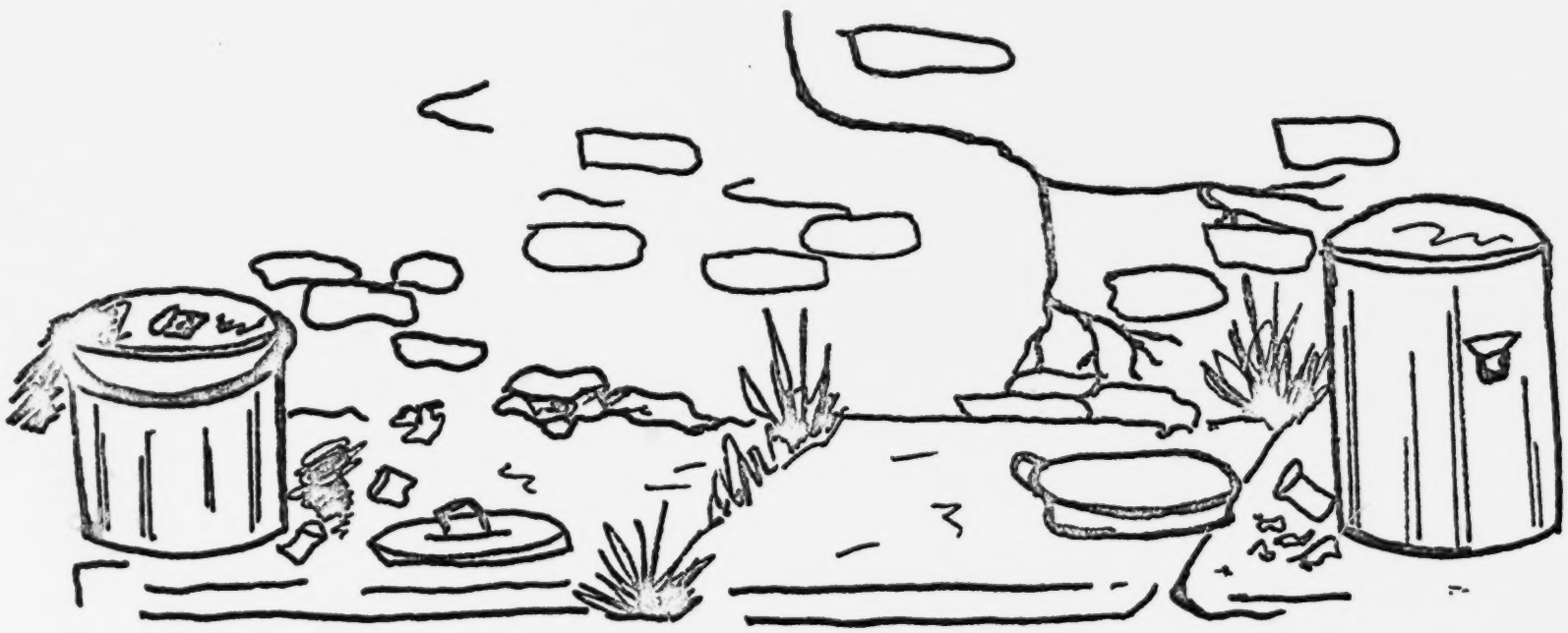
   b. There are fewer kinds of insects in the city. Only those which can live in the changed environment.

   c. What kinds of insects are found in the city?

   d. Why do people in the city try to get rid of these insects? How?

   e. What insects which live in the country but not in the city can give one pleasure?

   f. How might you encourage some attractive insects to live in a city environment?



HOUSE MOUSE

BACKGROUND:

These mice are common on ships and probably arrived here when settlers came. Adapted to indoor living, these animals share man's food. They gnaw through paper and wood and spoil much food, clothing, furniture, woodwork. They also carry disease.

One way to know of the presence of these animals is to see them directly. This is difficult since they are active mostly at night. However, they are frequently found running across a room, under furniture, and into a hole at the side of the room. Most commonly their presence is detected by indirect evidence such as by their droppings, several of which are provided in a plastic bottle, together with a nut showing mouse toothmarks, another bit of mouse evidence.

House mice are small, grayish brown. The belly is lighter. It has a scaly tail.

INVESTIGATIONS:

1. The best way to observe a house mouse is to catch one in a Hav-a-Hart trap which catches animals alive. You can then observe its color and behavior, but it will be a frightened animal. Perhaps the school custodian can capture one for such an observation. He can then dispose of it.

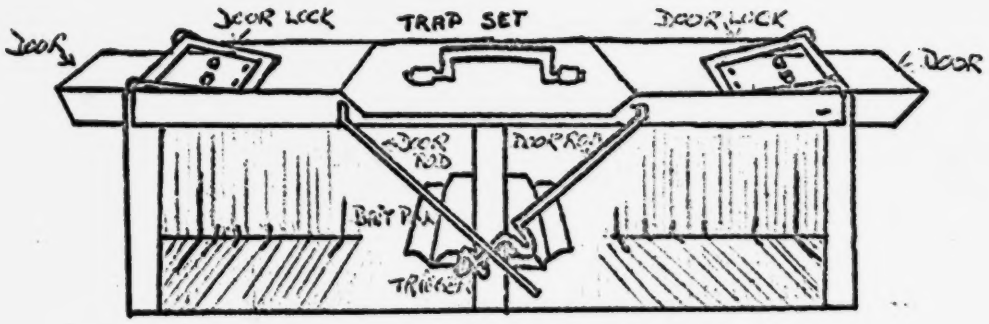
2. If there are holes in a room you can tell whether a mouse gnawed through by comparing toothmarks on the wall with those of the nut.

3. White mice, which are the same species as the house mouse, have been bred for laboratory use. A pair of these can be kept in captivity very easily. Behavior can be observed, reproduction rate can be recorded, food preference and effects of certain foods might also be investigated.

4. Mice may live four years. They can breed all year and they start breeding at age two months. If the females can give birth to a litter of six about once a month, how many mice might live in a new apartment house at the end of one year if you start out with one pair?

5. Discuss:

   a. How is the mouse's survival dependent on man?
   b. Why is the mouse so successful in spite of all efforts to destroy it?
   c. What are some of these efforts? Which are undesirable? Why
   d. How effective are cats as controllers of mice?
   e. Why do people fear mice?
   f. What is the best way to keep down the mouse population?



HAV-A-HART TRAP

PLANTS IN SIDEWALK CRACKS

BACKGROUND:

Cracks in sidewalks help children to realize that the sidewalk is on top of soil and that plants can grow wherever they have soil and other plant requirements such as adequate moisture and light.

Several plants which grow readily in cracks of city pavements are dandelion, plantain, peppergrass, ragweed, crabgrass. Specimen of each of these plants are provided. The fruit of the dandelion is protected in a plastic box.

INVESTIGATIONS:

1. Dandelion is a yellow head of many flowers. Each yellow part is a flower. Collect several heads to find out how many flowers each has.

2. Where are more dandelions growing - in sun or shade? Compare the size of leaves of dandelions in each of these locations.

3. How deep do the roots of dandelions penetrate?

4. How many fruits (each fruit contains one seed) does one dandelion head produce?

5. What makes plantain a hardy plant and one that is spread easily? Perhaps you can examine the root, its length, the number of flowers, the number and kind of seeds in order to find out what makes this plant so successful.

6. How might the number of seeds produced by peppergrass help it to survive in harsh city conditions? How might its root help it to survive?

7. Where, around the school, does ragweed grow? How tall is it? This plant blooms in the fall. Shake some pollen on a glass slide. Examine the pollen under a microscope in order to see one of the commonest causes of hayfever.

8. Why is crab grass sometimes called finger grass? How are the flowers and seeds of grasses different from other plants such as dandelion and ragweed?

9. Examine a section of the ball field where plants might be growing. Which do you recognize? In what kind of soil are these weeds growing?

Investigations (continued)

10. Try to transplant some of these weeds into pots or boxes with very rich soil. Place in the sun and water them. Keep a record of their progress. How successful is this transplanting?

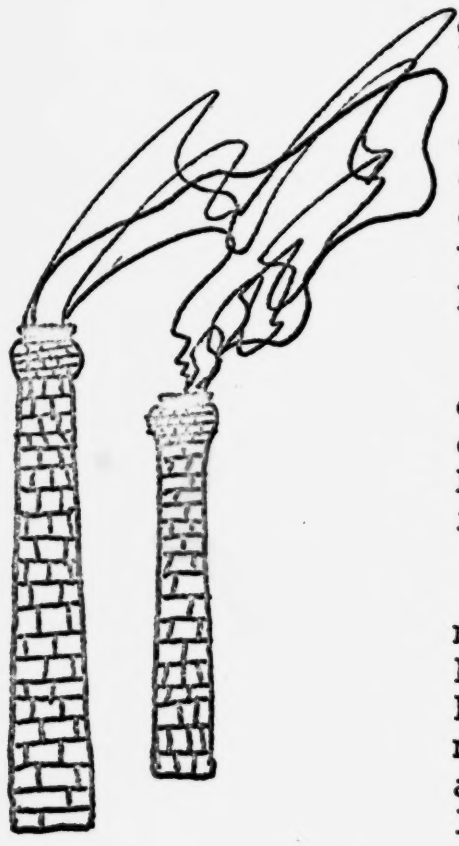
11. Discuss:

    a. So many of our weeds are not native. How did they get here?
    b. What helps them to survive?
    c. What is a weed?
    d. Why should ragweed be controlled?
    e. Why is spraying a poor control method?
    f. How did these plants start growing in cracks?
    g. How do the plants affect the cracks?
    h. Many animals use grass for foods. What are some of these animals?
    i. Which kinds of grasses do people use for food?

Common Plantain

Crab Grass

POLLUTED AIR



BACKGROUND:

Many air pollutants are visible. Evidence of damage by either visible or invisible pollutants can be observed. The materials included for investigations of the air serve to help children to observe visible pollutants and easily observable effects of polluted air.

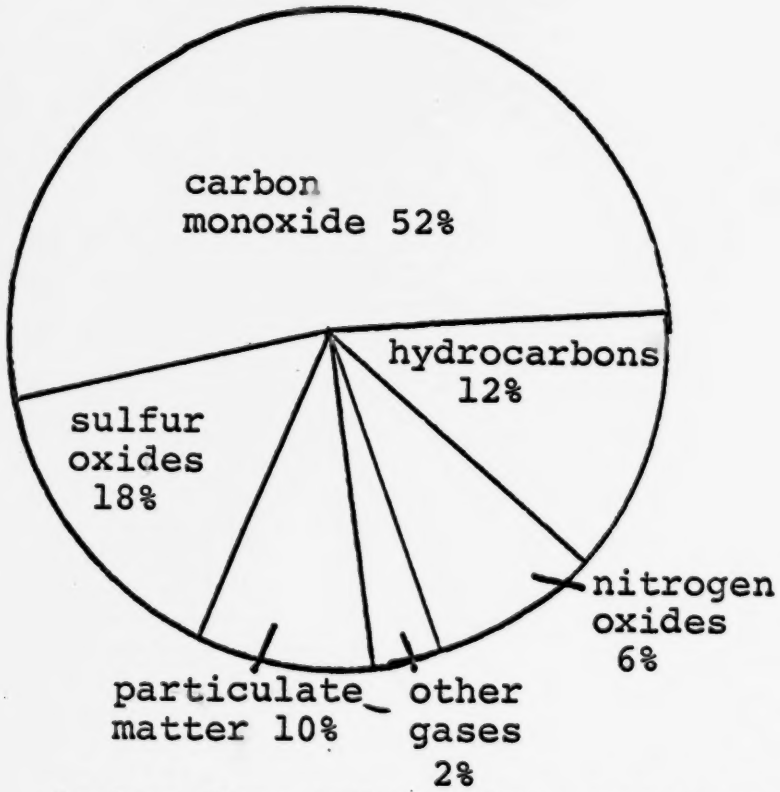
An acetate folder contains two pieces of cloth, one of which has been exposed to some car exhaust. A smoke-detection chart, a copy of the Ringelmann Smoke Chart and a glass slide are also included.

Air pollution includes the addition of materials to the air in our environment which affects health and property adversely. Air is contaminated by gases, particles, noise, pollen, radiation, and more things not yet identified. The seriousness of air pollution increases daily with our bulging population and concentration of people in large cities.

Air pollution studies fit into the curriculum at all levels and in such areas as health, science, social studies.

AIR POLLUTION IN THE UNITED STATES
(125 million tons per year)

TYPE OF POLLUTANT



(taken from NEWS FOCUS, October 20, 1967)

SOURCE OF POLLUTANT

59.9% Transportation
Trucks, automobiles and buses powered by internal combustion engines are the major emitters of carbon monoxide, hydrocarbons and oxides of nitrogen. Photochemical smog--new compounds are formed when sun shines on hydrocarbons and nitrogen dioxide.

12.5% Generation of electricity by burning coal and oil produces sulfur oxides.

18.7% Industry is the principal contributor of particulate matter, the part of fuel that cannot burn.

6.3% space heating

2.6% refuse disposal

A GLOSSARY OF SOME AIR POLLUTION TERMS

AFTER-BURNER - A burner in the effluent stream that completes the combustion, yielding cleaner stack gases. In cars - a special muffler that oxidizes CO & unburned fuel in the exhaust gases through a catalytic process.

AIR POLLUTION - The presence in the air of one or more air contaminants, naturally occurring or man-made, in quantities which may tend to be injurious to human, plant, or animal life, or to property, or which interfere with the comfort of life or the use of property.

BLOWBY DEVICE - A device put on autos to keep crankcase pollutants from being emitted into the air. It recirculates the emissions from the crankcase back into the intake system.

CARBON MONOXIDE - A colorless, odorless, highly poisonous gas (CO), produced by the incomplete combustion of any carbonaceous material.

FLY ASH - Gas-borne particulate matter arising from combustion of fuels and consisting essentially of fused ash and/or unburned material.

HYDROCARBONS - Any compound containing only hydrogen and carbon. Some hydrocarbons, such as benzene or methane, are produced by incomplete combustion of petroleum.

OZONE - (O_3) - A particular from of oxygen which is an irritating gas with a pungent odor. It damages plants and affects people with respiratory diseases.

PARTICULATE MATTER - (PARTICULATES) - Any material, except uncombined water, which exists in a finely divided form as a liquid or solid. Examples are dust, smoke, and fumes.

PHOTO CHEMICAL SMOG - A haze created by the action of sunlight on hydrocarbons and nitrogen oxides which are emitted from car exhausts.

RINGELMANN SMOKE CHART - A chart by which the density of smoke emitted from stacks is measured. It consists of a series of 5 cards, numbered 1 to 5, which range from light grey to black. The observer compares the density of the smoke with the shade of grey on the various cards.

SMOG - A combination of smoke and fog.

The meaning of the term "smog" has in recent years been broadened to include all conditions of high atmospheric pollution caused by a complex mixture of gases and suspended

(A Glossary of Some Air Pollution Terms - continued)

particulate matter, both solid and liquid, characterized by a marked reduction in visibility and by certain physiological responses in human beings such as eye, nose and throat irritations. Smog is also capable of producing plant damage. The term "smog" is now generally used to denote any high or intense air pollution condition, such as the condition experienced in Los Angeles.

Another term, "smaze", was coined to designate a condition descriptive of a combination of smoke and haze. Smaze is also characterized by a reduction in visibility. It was thought at one time that smaze created a lesser physiological effect on humans and plants than "smog"; hence the distinction. However, more recent developments indicate that this may not be true. In any case, the term has not found wide usage. Usually the haze results from a widespread meteorological phenomenon, and when combined with the smoke of an urban area, becomes smaze. On the other hand, smog usually denotes a condition which is totally generated in a local urban area.

SOILING INDEX - A number representing the soiling properties of the air, as measured by a tape sampler which collects suspended particulates on filter paper.

SULFUR DIOXIDE - (SO_2) - A colorless gas with an acrid odor, which is created mainly from the burning of coal and oil. High humidity intensifies its effects. It can injure the respiratory system.

SULFURIC ACID - An acid which corrodes metal. It is created when sulfur dioxide (SO_2) is emitted into the air and becomes sulfur trioxide (SO_3). When sulfur trioxide mixes with water, it forms sulfuric acid.

THERMAL INVERSION - A condition caused when a cool air mass moves in <u>under</u> a layer of warm air. The layer of warm air holds down the cool air, acting like a lid on a pot, trapping air pollutants near the ground.

<u>INVESTIGATIONS</u>:

1. Expose slides covered with a thin layer of petroleum jelly. Compare them after 1 hour, 1/2 day, 3 weeks.

2. Trap particles in a cloth filter from automobile exhaust by tying a piece of clean muslin over the exhaust pipe and running the engine for two minutes.

3. Expose white tissues to the air for varying lengths of time noting wind, weather, etc.. Note variations in whiteness of snow around school yard.

Investigations (continued)

4. Observe your local incinerator in action, if possible. With a Ringelmann Smoke Chart determine the density of smoke. If you have occasion to make repeated trips, keep a record of the density. How well does the smoke density keep to the legal requirements of your community?

5. Observe smoke stacks of power plants and factories and home chimneys at different times of the day. Keep a record of the smoke density with the Ringelmann Smoke Chart.

6. Identify sources of air pollutants (automobiles, factories, furnaces) in your neighborhood. Photograph them.

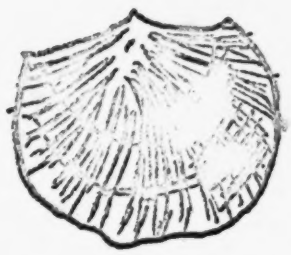
7. Find trees which have been planted near bus stops. Compare the condition of these trees with others which have been planted elsewhere.

8. Leave some clean gallon jars on the roof of the school building for about a month. Compare with a similar jar kept in a paper bag indoors during that same period of time.

9. Discuss:

   a. Most harmful pollutants are produced by vehicles. Even when they are not moving poisons are given off. What can be done?
   b. The speed of cars causes tiny particles of rubber from tires to enter the air. These never settle and we breathe them in. They cause serious lung disease. A car would have to go no more than ten miles an hour in order to be safe. What can be done?
   c. There is no question that smoking is harmful to health. In large cities such as New York City the air is so bad that even if one does not smoke the result of breathing that air is equal to smoking 38 cigarettes a day. What can be done?
   d. Many devices for preventing pollutants from entering the air are now available on the market. This is very expensive and manufacturers continue to hesitate to invest millions of dollars for such protection. If they do make this investment everything will be more expensive: cars, manufactured goods, power, rent, taxes. What can be done?
   e. Who is responsible for air pollution in your neighborhood?
   f. Whom can you notify of these air pollutors? How can you make sure that something is done to remedy this situation?

ROCKS: MANMADE AND NATURAL



BRACHIOPOD

CRINOID

BACKGROUND:

In a marked container you will find two manmade rocks: concrete and brick, a bag of sharp sand, a piece of polished limestone showing fossils (crinoids and brachiopods), as well as a square of unpolished limestone. (Brachiopod - a prehistoric marine animal, a bivalve. Clams are living bivalves. Crinoid or sea lily - an animal with a stem-like structure which is attached to the bottom of the sea - the starfish belongs in the same group. Crinoid forms are now living. Some forms existed in prehistoric times.) A vial contains a piece of chalk. A mixing spoon, measuring spoons and a measuring cup are included to aid in making the suggested investigations.

One thing that all the specimen have in common is that they come from the earth. Cement is manufactured from limestone and clay. Concrete has sharp sand, cement, and sometimes other materials added to it before it is made into a molded stone.

Bricks are made of clay. They are formed into blocks and baked.

Limestone is a natural sedimentary rock. Sedimentary rocks are formed from particles settling down in water. Limestone is used directly as a building stone as well as for making cement.

Chalk is a limestone product.

Limestone and limestone products bubble or fizz when acid is added to them. A 5% solution of hydrochloric acid can be mixed at the drugstore and used for testing limestone. Vinegar (slightly warmed is better) is a fair substitute and safer for children to use.

Investigations:

1. Pour some vinegar on the chalk in the plastic vial. What do you see? What do you hear? This is a test for limestone.

2. What happens when some vinegar is poured on the limestone specimen?

3. Fossils are frequently found in limestone rocks. Examine both limestone specimen to see fossils. A magnifier is useful.

4. Polished limestone, frequently with fossils clearly seen, can be found outside buildings and in hallways. Where in your neighborhood are such limestones used? Look inside buildings as well as outside.

Investigations (continued)

5. Make a survey inside and outside the school in order to determine where natural stone is used and where artificial stone is used. What parts are made with cement and concrete?

6. How can sidewalks be patched with cement? First, see how cement is made by making some from the materials which are provided. Mix 1/4 cup cement with 3/4 cups sand in the container. Add some water slowly, mixing with the mixing spoon until the mixture is somewhat like mud. Measure the amount of water you use. When this dries you have cement.

   After obtaining necessary permission for this repair job, obtain some cement. Examine it as to color and texture. Different brands require the addition of different materials. Follow the directions. Make a cement mixture. Apply to broken areas. Put up a barrier to prevent people from stepping into the fresh cement. Put up a warning sign.

   Touch the cement several times during the day and for several days in order to determine whether it is hardening.

7. Does the temperature of the water affect the rate at which cement hardens? Make four mixtures of cement in four identical pie pans. Use the same amounts of all the ingredients. The only variation will be the temperature of the water. To #1 add cold tap water. To #2 add ice water (made from mixing ice cubes with water). To #3 add hot tap water (either from the tap or heated without bringing to a boil). To #4 add boiling water. Label each pan. Inspect each mixture at once, then hourly, keeping a record of observations.

8. How is concrete affected by the amount of water used in the mixture? Obtain some cement, coarse sand, and water. (The amounts roughly are: 1 cup cement, 3 cups sand, and enough water to produce a mud consistency). First mix the sand and cement, then add the water slowly as you stir. Make several different batches, each with a different amount of water. Label. Observe results and keep a record.

9. Discuss:

   a. Many poisons such as acids from steel and paper mills, various kinds of drug poisons and radioactive wastes are being pumped into the ground. Some are pumped into steel containers and others directly into the ground to spread out between rock layers. These wastes used to be poured into rivers and lakes. What are the possible consequences of this new practice? What should be done? By whom? When?

   b. Why has the dumping of products directly into bodies of water been stopped?

   c. What health hazards do workers suffer who are engaged in industrial stone polishing?

Discussion (continued)

d. How does polluted air affect stone buildings?

e. What kinds of building materials are being used in place of stone in new buildings?

f. How does glass and steel make a building more attractive? less attractive? cheaper or more expensive to build? more or less comfortable indoors?

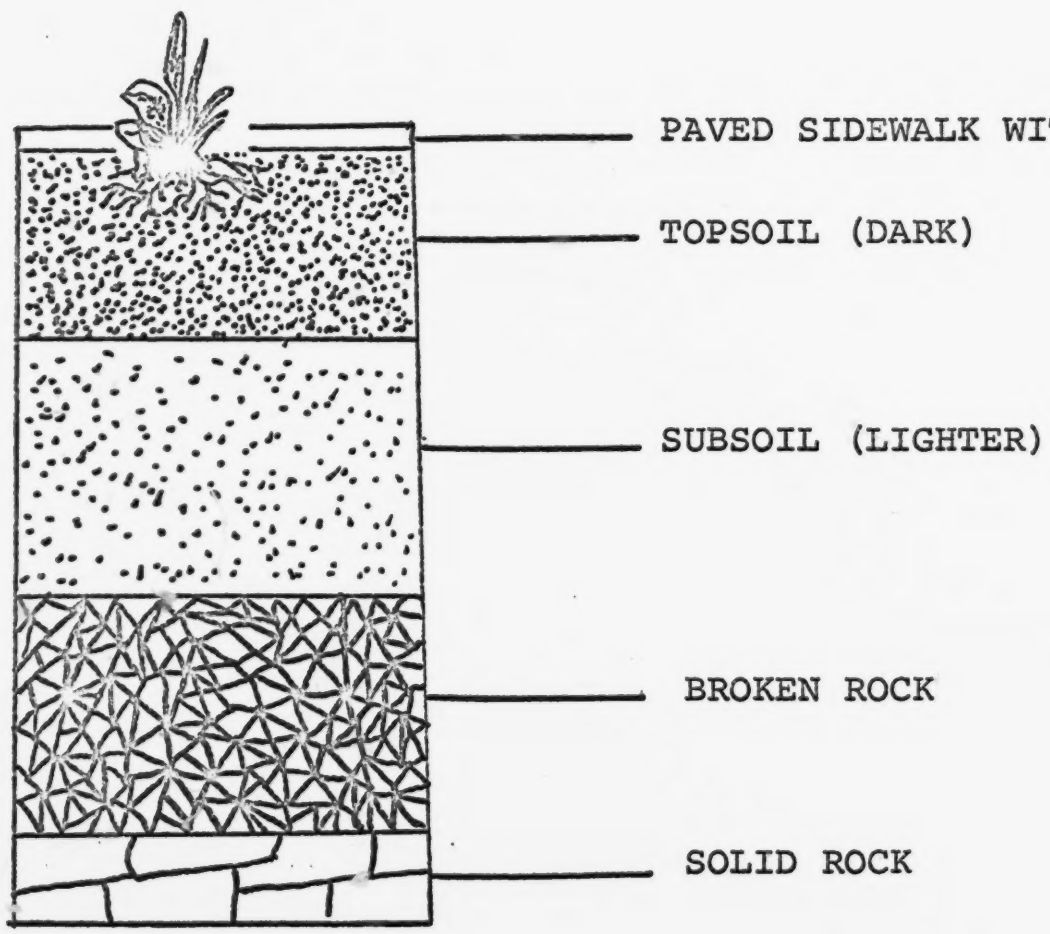
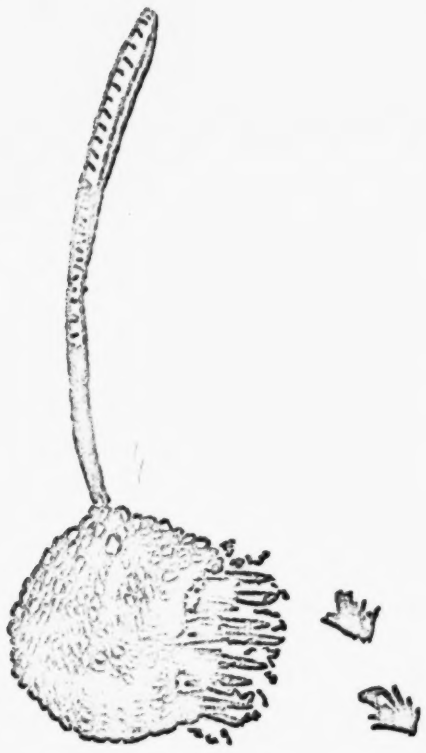


DIAGRAM: UNDER A CITY STREET



SEED "PACKAGES"

BACKGROUND:

Children are familiar with seeds in a commercial package such as the radish seeds. But there are many natural seed "packages". An orange is a seed "package". So is a green pepper, a peach, a cucumber.

Some common natural seed "packages" available in the city are the fruits of sycamore, catalpa, ailanthus, Norway maple. Samples of these are included, as well as a little stuffed sock with "stickers" (burdock) and "beggar-ticks" (bidens) adhering to it.

The sycamore is a common street tree. Its fruit balls hang high and can be seen almost all year, especially when the leaves fall. Collect these after a winter storm. There are many seeds in each ball.

The ailanthus (Tree of Heaven) has its fruits in bunches which can be easily collected. The male and female trees are separate.

After the beautiful catalpa flowers fall the long fruit pods develop with their interesting seeds. Pods can be collected from the ground at any time of year.

The Norway maple "key" is a winged fruit which separates easily. Handfuls of these can be collected in the fall.

The "hitchhikers", burdock and bidens are among the common fruits which might cling to one's socks when walking through a vacant lot or weedy yard.

INVESTIGATIONS:

1. Compare the fruits of the four trees. Describe each of these seed "containers" or seed "packages". How are the seeds arranged in each? How is each seed adapted to be scattered by the wind? What do the seeds of the sycamore and the catalpa have in common? the seeds of ailanthus and maple?

2. If you have a Norway maple outside find out when it flowers, when the seeds form, when they fall, when they begin to grow?

3. How successfully can you get maple seeds to germinate, grow into little trees, and continue to grow outdoors?

4. If you have a catalpa tree or ailanthus tree try investigations 2 and 3 with these.

Investigations (continued)

5. Find a sycamore tree. Count the number of fruits (or buttonballs). Can you discover how many seeds one tree may produce year after year? How do you explain the fact that you usually do not see many sycamore trees in one place or near each other?

6. By dividing the fruit into small sections each pupil can count the number of seeds in his section. To discover the total number of seeds, add all the amounts.

7. Plant some sycamore seeds in containers indoors. Give them water but keep some very dry and some very moist, some cool and some warm, some in sunlight, and some in shade. Discover which grows best.

8. Plant some sycamore seeds outdoors. Plant some on the shaded side of the building, and some in the sun. Arrange to water some of each group a great deal, while the others get whatever water the rain provides. Observe how they grow. Now you can discover whether sycamore trees grow more successfully indoors, or outdoors, in the shade or full sunlight, with much water or little water.

9. What causes the burdock fruit to stick to the sock? Can you discover whey these are called "stickers"?

10. Discover the kind of fabric to which the burrs stick best, and to what kind least. Try many different samples: silk, wool, paper, cotton, velvet, aluminum foil, etc. How could you dress so as to avoid the "stickers"?

11. Can you discover where burdock grows around the school? Do they stick out above the snow? Do you see any animals eating them?

12. How is bidens or beggar-ticks (bidens mean two teeth) adapted to stick to the sock? Where in your neighborhood can you find some? How does this habit of sticking spread the growth of this plant?

13. Try to grow some radish seeds in containers indoors, outside in a shady spot, outside in a sunny spot. How many radishes developed in each place? What develops before the radish does? What part of the plant is the radish?

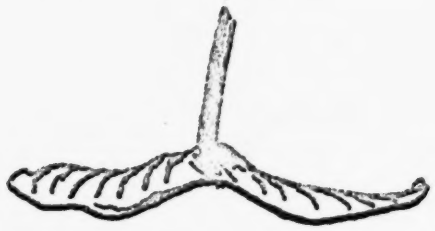
14. Investigate other sources of seeds such as oranges, apples, peaches, cherries, cucumbers, green peppers. Try to grow these indoors and outdoors.

15. Discuss:

    a. What conditions help to determine the growing success or failure of certain plants?

Discussion (continued)

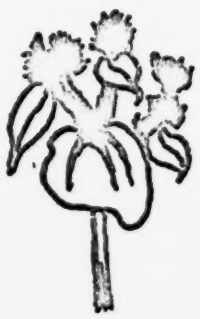
b. Why are there so few plants in the city?
c. Why are plants important to people?
d. What are some advantages of growing plants in the city?
e. What part of your school neighborhood might be improved with plants? Draw up some plans. Try to carry out such a local beautification program.



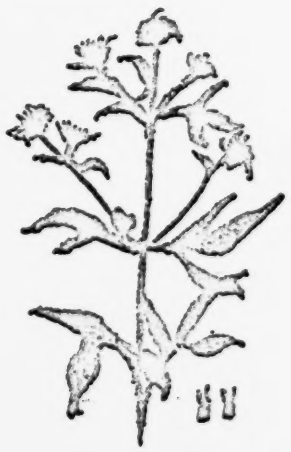
NORWAY MAPLE FRUIT

CATALPA POD

AILANTHUS FRUITS

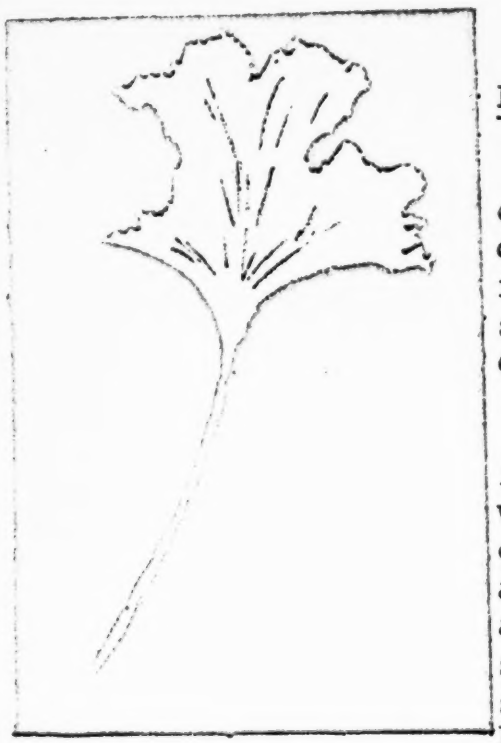


BURDOCK



BEGGAR-TICKS

TREES: BARK AND LEAVES



GINKGO LEAF

BACKGROUND:

Only certain trees are tolerant of urban conditions. The soot and other dusts, polluted air, dogs, physical abrasions make life almost impossible for trees to survive in cities. This section presents some investigations concerning the bark and leaves of several common trees.

For bark studies a specimen of Norway maple is included. It has a dark ridged bark. This specimen was obtained in the country in order to show lichen growing on it. Lichen cannot survive in polluted air and is therefore seldom or never found in cities although the Norway maple is one of the commonest street trees. So is the sycamore with its mottled smooth bark. Ailanthus also has a smooth bark. The bark of the locust is ridged.

Birch is sometimes grown as part of foundation plantings in front of apartment houses and other buildings. A small section of gray birch is enclosed for bark color contrast. An example of a rubbing made of the birch bark, some reindeer lichen, some sycamore bark, cinnamon bark are all included to aid in the suggested investigations.

The ailanthus, the Tree of Heaven, has compound leaves which have a strong smell when bruised. The stout twigs and large leaf scars are easily observed.

The leaves of the locust are also compound in contrast to the sycamore leaf which is simple, with three broad triangular lobes with coarse teeth. The Norway maple has thinner simple leaves with five lobes each. The ginkgo has fan-shaped leaves with parallel veins.

Practice in sorting things is included as part of the study of shapes of leaves of city trees. A folder of leaf samples includes those of the Ailanthus Tree, Honey Locust, Norway Maple, Ginkgo. In addition there is a bag of assorted dry leaves.

Investigations of Bark:

1. Examine the piece of sycamore bark. Compare its fragrance to that of the cinnamon bark. Then crush some of the bark of each and compare their odors.
2. Count all the trees on your square block. How many are dead or in poor condition? Of these, how many are sycamores?
3. If you rub the side of a fat dark crayon on a piece of tracing paper held firmly over the log you can discover the pattern of the birch bark.

Investigations (continued)

4. Make bark "rubbings" of other trees around the school and compare these to the birch "rubbings." Play a guessing game with the bark "rubbings." Exchange "rubbings" and try to match these with the trees from which they were made.

5. Examine some wooden spools and clothes-pins. How much do they resemble the gray birch wood? These are the kinds of things which are made from gray birch. Perhaps you can discover other uses for gray birches.

6. How are the four kinds of leaves the same? How are they different?

7. How many trees do you find near your school with each kind of leaf? Make a picture of each kind on a separate card. Make a check on the card whose picture matches each tree you find.

8. What shapes are the leaves on the ground around the school? Collect any 12 leaves lying on the ground. Assort them so that each of one kind are in the same pile. Now match the kinds you collected with the samples on the card. What different shapes did you find?

9. Are there more different sizes of leaves or more different shapes of leaves? You can find fallen leaves at any time of the year. Collect as many different sizes as you can. Match them. If any are the same size, throw all away except one. Count how many different sizes you have.

Now go out and collect as many differently shaped leaves as you can find. Count these.

Compare your two collections. In which are there more leaves, in the different sizes or the different shapes?

10. How different are the shapes and sizes of leaves on one tree? You might investigate a bush instead of a tree if this is easier. Compare the sizes of the leaves on the same plant as well as their shapes.

11. Examine a plant in your classroom. Compare the sizes and shapes of the leaves to find out whether they are all exactly the same or whether there are differences.

12. In winter, compare the twigs and the marks on the twigs of the four trees. (Some varieties of honey locust have thorns and some do not.)

13. The leaves in the bag are at least a year old. Allow them to dry out. Then crush them. Try to grow some seeds in a container of sand (not beach sand). Set up several other containers of the same size into which some sand plus crushed leaves have been added. Plant the same number of the same seeds (Radish is good. So are lentils, peas, etc.) in each container. Give all plants the same amount of light and water. Keep a record of daily observations. What differences do the dry leaves make?

Investigations (continued)

14. Examine the bag of leaves. These are probably different from the leaves found on trees near your school. How many of the leaves are whole and how many have pieces which are missing? Can you judge which are older and which are younger?

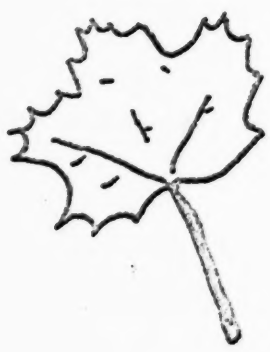
15. Discuss:

a. It is thought that sycamore trees can tolerate city conditions because of their peeling barks. How can you explain this? Have you any other ideas why they are so hardy?

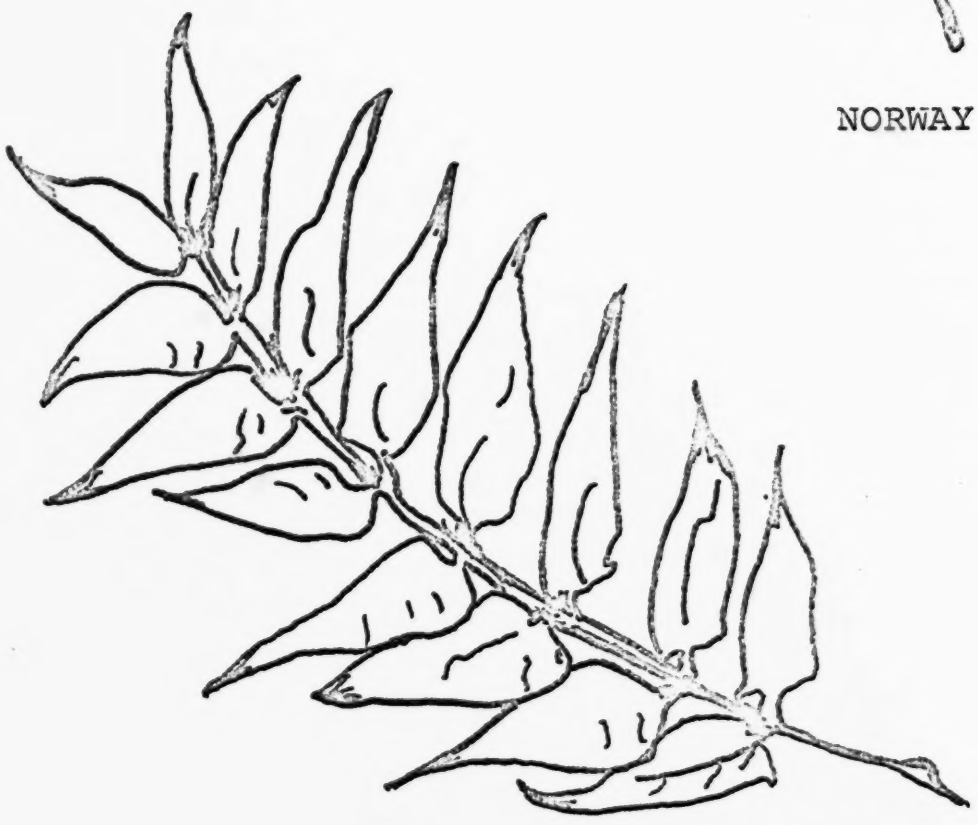
b. How might the large quantity of city soot which falls on the leaves interfere with the life of the trees in the city?

c. Where in your neighborhood might dead trees be replaced?

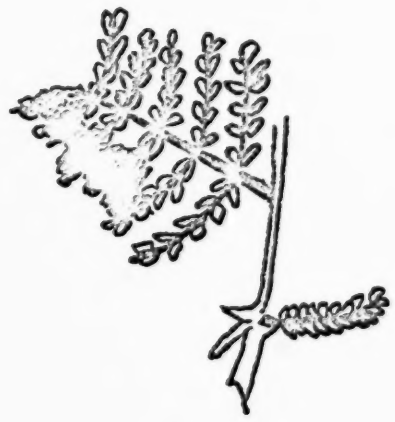
d. How can the condition which is destroying these trees be removed?



NORWAY MAPLE



AILANTHUS



HONEY LOCUST

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